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METHOD FOR THE PRODUCTION OF A FLANGE ON A METAL BLANK, AND TRANSMISSION PART

[0001] The invention relates to a method for the production or construction of a flange on a circular metal blank by means of one or more pressure rollers rotating relative to the circular metal blank, and to a transmission part having such a flange.

[0002] From German Patent Document DE 44 00 257 C1 as well as the parallel members of the patent family (among others, the European, U.S. and Japanese patent documents), it is known to construct a hub on a circular metal blank in a non-cutting manner in that a metal sheet bar or blank carried by a tool of a main spindle and rotating relative to one or more pressure rollers, first applied slightly axially and then, after the sinking into the circular blank, applied radially, is reduced in its thickness by pressing by means of the pressure roller and is shaped into a cylindrical projection protruding from the metal sheet bar, which projection penetrates the circular metal blank. This method is reliable and cost-effective and has had good results in practice. It is particularly suitable for producing hubs which project axially relatively high from the surface of the circular metal blank facing the hub. The circular metal blank is held on its outer circumference by means of clamping chucks.

[0003] From German Patent Document DE 44 44 526, it is known that the circular metal blank is not held by means of clamping chucks but by means of an abutment chuck which has a ring-shaped construction and a slightly larger inside diameter

than the circular metal blank in its starting condition. During the first sinking of the pressure roller into the axial surface of the circular metal blank, the latter is pressed on its outer circumference against the inner circumference of the abutment chuck and is held there in a secure manner. Then the pressure roller is moved axially toward the interior so that, again in the manner of German Patent Document DE 4400257C1, a hub forms around a center mandrel or the like.

[0004] Based on this state of the art, it is an object of the invention to provide a method by means of which also "flatter" hubs, in the following called flanges, can be produced in a non-cutting manner on circular metal blanks. In particular, flanges are to be constructed on the metal roll whose radial ring width is greater than their axial height. In particular, it should also be possible for the flange to be slightly thicker than the starting material.

[0005] This task is solved by the object of Claim 1.

[0006] Accordingly, the method of constructing a flange on a circular metal blank has at least the following steps:

[00002] By means of a pressure roller, a structure which, in particular, is conical and tapers toward the mean perpendicular of the circular metal blank is formed on the circular metal blank, and

[00003] a flange is formed from the conical structure by means of a subsequent treatment.

[0007] As an alternative, the method for the production of a flange on a circular metal blank may also comprise the following steps:

[00004] By means of at least one rotatable pressure roller, the axial thickness of the circular metal blank is reduced at least in sections along its radial dimension and the material is shaped into a hub-type and/or conical structure,

[00005] from the structure which has the shape of a hub and/or is conical particularly toward the mean perpendicular, a flange is formed on the circular metal blank by means of a subsequent treatment.

[0008] In particular, it is conceivable that the axial dimension of the flange is smaller than its radial dimension. However, the flange should preferably be axially thicker than the initial workpiece. Particularly preferably, the radial dimension of the flange is more than twice, particularly more than three times as large as its axial dimension, which is advantageous particularly when implementing starter rims with relatively flat flanges made of thin circular blanks as the initial workpiece.

[0009] The circular blanks with flange attachments which can easily be produced in such a manner in a few steps from circular metal blanks are particularly suitable for the production of engine and transmission parts of all types which are to have a flat flange attachment in the median area, particularly around a centric hole extending through the circular blank.

[00010] The forming of the conical structure can particularly take place in the most simple manner in that the adjustment angle (α) of the pressure roller relative to the axial surface of the circular metal blank is greater than 90°. Particularly good results are achieved when the angle of adjustment (α) of the pressure roller relative to the axial surface of the circular metal blank is greater than 110° and smaller than 170°, particularly greater than 115° and smaller than 150°.

[00011] Advantageous further developments are indicated in the subclaims.

[00012] Preferably, the circular metal blank is held on its outer circumference by an abutment chuck. In addition, it is advantageous in the case of very thin circular metal blanks (for starter rims, etc.) for the circular metal blank to be held down on its side facing the pressure roller at least in sections in the outer area by means of a ring. In this manner, "thin" starter rims for engines can be manufactured particularly well, in which case a rim with an inner flange can be produced from a disk-type circular blank having a thickness of only a few millimeters (less then five millimeters). In this case, the circular blank is reduced to a thickness of, for example, only 3 mm in a median radial area. Then the resulting inner projection is

reshaped without cutting to form the flange (particularly on a press), and the outer edge can be formed in a manner known per se in the fashion of a starter rim.

[00013] The flange is preferably constructed on the side of the circular metal blank facing away from the pressure roller.

[00014] However, surprisingly, it is also conceivable for the flange to be constructed on the side of the circular metal blank facing the pressure roller if the tool has a corresponding recess in the area provided for the flange. Likewise, it is conceivable for the flange to extend on both axial sides of the circular metal blank.

[00015] Another advantageous embodiment is characterized in that the flange is pressed into a tool having a contour, particularly a toothing, so that, on its side facing the tool, the flange is provided with a corresponding contour, particularly a toothing.

[00016] The invention also creates a transmission part with a flange, particularly around a centric bore, the flange of the transmission part being produced according to a method of one of Claims 1 to 21 and being connected in one piece with the remaining transmission part. This transmission part is preferably constructed as a starter rim which is produced from a circular blank of less than 7 mm, particularly less then 5 mm, preferably less than 4 mm, in which case the starter rim in sections is thinner than the initial width of the circular blank, and in which case the starter rim has a flange toward an inner passage hole, which flange is formed on in one piece by pressing and is more than twice, particularly more than four times as wide (radial dimension) as it is high (axial dimension).

[00017] In the case of the starter rim according to the state of the art, the flange was produced from a separate ring which was place on a circular blank. Surprisingly, this can be eliminated according to the invention. Preferably a gear rim is attached or shaped in one piece to the outer circumference of the starter rim. The appearance of the starter rim is basically similar to that of Figure 4. However, the proportions are different because the flange is only slightly higher than the initial circular blank (Figure 5).

[00018] In the following, the invention will be described in detail by means of embodiments with reference to the drawing.

[00019] Figure 1 is a view of a circular metal blank as the starting workpiece before its machining;

[00020] Figure 2 is a view of the circular metal blank during a first machining step;

[00021] Figure 3 is a view of the circular metal blank of Figures 1 and 2 during another operating step, schematically two different possibilities being shown for implementing this operating step; and

[00022] Figure 4 is a view of the circular metal blank with a non-cuttingly produced flange section;

[00023] Figure 5 is a view of a blank machined according to the method of the invention for producing a starter rim.

[00024] Figure 1 illustrates a disk-shaped circular metal blank 1 which is penetrated by a centric bore 2 and which, in the manner of Figure 5, is placed in a tool which rotates about the axis S during the machining.

[00025] In the following the axial thickness of the circular metal blank 1 in its starting condition is marked with the reference symbol "d"; the radius of the centric passage hole 2 before the machining has the reference symbol "r1" and after the machining has the reference symbol "r2"; the axial dimension of the flange 7 - Figure 4 - after the machining has the reference symbol "a" and the radial dimension has the reference symbol "b".

[00026] As the starting workpiece, the circular metal blank 1 is placed in a tool and is held on its outer circumference, preferably by an abutment chuck in the manner of German Patent Document DE 44 44 536 C1. Its centric bore 2 may be penetrated by a preferably conically shaped centric mandrel.

[00027] The actual machining at first follows the method described in German Patent Document DE 44 00 257 C1 or DE 44 44 536 C1; that is, preferably at least one rotatable pressure roller 3 rotating relative to the circular sheet metal blank sinks at first axially from the outside into the axial side of the circular metal blank

1 rotating with the tool, the axial side facing away from the tool (not shown here), so that, when a ring-type abutment chuck is used, this circular metal blank 1 is at first form-lockingly placed on the inner circumference of this abutment chuck.

[00028] As a result of the simultaneous or subsequent movement of the pressure roller 3, which rotates relative to the circular sheet metal blank, radially toward the interior - toward the bore 2 -, a hub-type or hub-like conically tapering structure 4 is formed on the inner circumference of the circular metal blank 1 or on the bore 2. This structure 4 on the inner circumference of the circular metal blank projects in a conical shape radially to the outside because the angle of adjustment α on the advancing flank 9 of the pressure roller 3 relative to the surface of the circular metal blank is negative or greater than 90°. The angle of adjustment preferably is between 110° and 170°, particularly between 115° and 140°.

[00029] The conical structure 4 will then be subjected to a subsequent treatment for forming the flange 7, in order to achieve a shape, where the axial height of the flange is smaller than its radial dimension "b".

[00030] This subsequent treatment can take place by means of another pressure roller which is constructed in the manner of a rotatable pressure or adjustment roller 5 which is guided radially from the outside to the inside or, by means of an additional pressure roller 6, which again is guided axially from the outside to the inside, specifically such that, directly in the next operating step, the shape of a flange is formed from the conical structure (particularly around a centric mandrel). The adjustment angle of the additional rotatable pressure roller 6 is preferably at approximately 90°.

[00031] It is also conceivable that, when forming the conical structure, simultaneously an axially and/or radially applicable rotatable hold-down roller (see reference number 15 in Figure 5) of the type of the adjusting roller 5, is also running on the side of the circular metal blank situated radially opposite the pressure roller, which hold-down roller presses down the circular metal blank at

least in sections so that the latter does not lift off the tool or arch forward from the latter in the area in which the pressure roller 3 is moving.

[00032] As an alternative, a subsequent treatment with other devices is also conceivable, thus, by means of a press or the like, which then, as an alternative, shapes the flange from the hub-type structure. However, the subsequent treatment in the same chucking arrangement with another forming roller is preferable and simple.

[00033] Although another operating step is therefore required for forming the flange 7 - in contrast to the forming of a hub according to the above-mentioned type -, specifically the subsequent treatment of the conical structure, it surprisingly becomes possible by using a forming and non-cutting cold-working pressure forming method to precisely construct also very flat flanges on circular metal blanks whose diameter is smaller than the starting diameter of the circular metal blank 1.

[00034] As an alternative, it is also conceivable to carry out the sinking directly from the outer circumference radially into the workpiece (if, for example, the axial dimension of the abutment chuck is slightly smaller than the thickness of the circular metal blank).

[00035] According to Figure 1, in which the sinking-in takes place slightly offset from the outer circumference of the circular metal blank 1 toward the inside, the additional advantage is achieved that an area 8 remains on the outer circumference of the circular metal blank 1, which area 8 can be subjected to a subsequent treatment, for example, in order to form a profiling of the type of the profiling of a pulley or a toothing of a starter rim or the like (not shown).

[00036] A contour, such as a toothing, can be formed in the tool 11 (in the first or in an additional second tool), so that the flange is provided with a corresponding contour (particularly a toothing 10) during the pressing or the like.

[00037] Figure 5 illustrates a blank 12, which was machined according to the method of the invention and produced from a flat circular metal blank for

producing a starter rim. A tool 11 is easily visible which has an outer abutment ring section 13, a ring 14 placed (or pressed) on for holding down the relatively thin circular metal blank 1 in the outer area, and the possibility of additionally pressing the circular metal blank also between the outer circumference and the inner flange in sections (to be?) thinner or thicker and/or pressing it in the direction of the axis S (to be ?) conical and/or stepped against the correspondingly constructed bottom die of the tool.

[00038] This can take place by means of the pressure roller 3 or an additional pressure roller or the hold-down roller (indicated as the hold-down roller 15). Here, the flange was pressed from the conical structure into the tool 12 on the side situated opposite the machining by means of the pressure roller 3.

[00039] If a toothing (such as a radial toothing) were formed in this area, a toothing of the type of the toothing 10 would additionally be formed in the flange (not visible in Figure 5).

Reference Symbols

Circular metal blank	1
bore	2
pressure roller	3
conical structure	4
adjustment roller	5
pressure roller	6
flange	7
area	8
advancing flank	9
toothing	10
tool	11
blank	12
abutment ring section	13
ring	14
height	a
width	b
radii	R1, R2
thickness	d
median perpendicular	S
angle	α